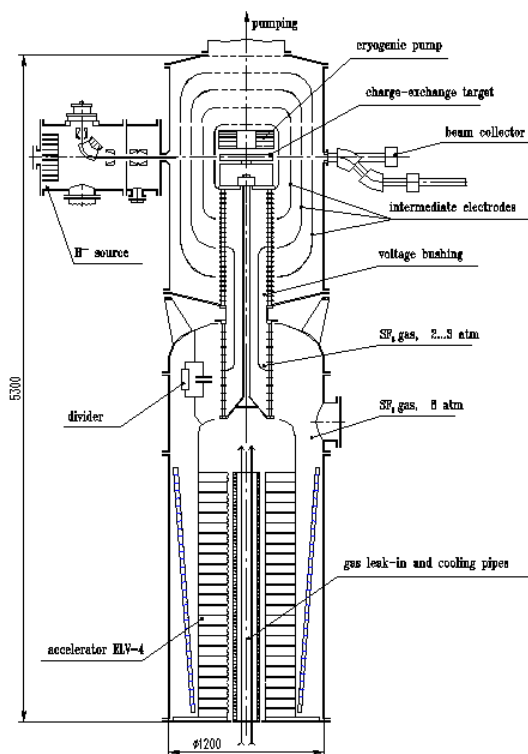


Vacuum Insulated Tandem Accelerator for Counter Terrorism Applications

A new high current vacuum insulated tandem accelerator can be used for production of monochromatic photons for detection of explosives and other contraband. Prior efforts to use the method of nuclear resonance absorption (NRA) to detect nitrogen using the inverse reaction $^{13}\text{C}(p,\gamma)^{14}\text{N}$ failed due to limitations of the accelerator to transmit the necessary proton current. The vacuum insulated tandem (VITAN) accelerator is designed to transmit up to 40 mA of protons at energies up to 2.5 MeV. The accelerator features:



- No glass or ceramic accelerating columns for beam transport. The charge exchange canal is situated in a vacuum tank and high voltage is applied to it through an insulating column that is remote from the transport region of the high current ion beam.
- The gas stripper canal is enclosed in a system of coaxial cylindrical shells that provide an optimum potential gradient for beam focusing and for grading the potential to prevent high voltage discharge. The shells are vacuum transparent because they possess a large number of openings.
- Apertures in the walls of the vacuum tank and in the coaxial shields focus the accelerated ion beam.
- Efficient pumping of the inner cavity, which contains the gas stripper, is accomplished by a combination of cryogenic recirculating pump in the

vacuum vessel and conventional turbo-molecular pumping through the removable covers of the cylindrical shields.

- Energy resolution is $\sim 0.1\%$.

The accelerator can be used to drive several reactions that are useful for detection of materials and mapping of hidden spaces (PIPA). Example processes include:

Reaction	Energy (MeV)	Application
$^{13}\text{C}(p,\gamma)^{14}\text{N}$	1.7476	MeV Photons for <u>Nuclear Resonance Absorption (NRA)</u>
$^{19}\text{F}(p,\alpha e^+ e^-)^{16}\text{O}$	1.8 – 2.3	Positrons for producing tunable source of MeV photons by In-flight Annihilation for NRA
$^{19}\text{F}(p,\alpha\gamma)^{16}\text{O}$	1.8 – 2.5	MeV Photons for <u>Photon Induced Positron Annihilation (PIPA)</u>
$^7\text{Li}(p,n)^7\text{Be}$	1.8 – 2.5	Epithermal to MeV Neutrons

The accelerator will be built through a collaboration of Brookhaven Technology Group, Inc., Setauket, NY and Budker Institute of Nuclear Physics, Novosibirsk, Russia.